

MICROHABITAT USE BY THE WHIP SPIDER *HETEROPHRYNUS LONGICORNIS* (AMBLYPYGI, PHRYNIDAE) IN CENTRAL AMAZON

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ABSTRACT. We investigated microhabitat selection in the Amazonian whip spider *Heterophrynus longicornis* (Butler 1973). The probability of finding individuals of this species increased according to the diameter of the trees. Moreover, there was a positive correlation between the size of adult individuals and the diameter of the trees on which they were found. Our results also provide quantitative support for a previous suggestion that *H. longicornis* prefers large trees bearing buttresses and burrows at the base where the individuals hide during daytime. Since whip spiders prefer large trees, the anthropogenic disturbance promoted by selective logging or the degeneration of the forest structure due to fragmentation and edge effect may have a negative effect on the spatial distribution and, consequently, on the density and population ecology of *H. longicornis*.

Keywords: Brazil, buttress, conservation, ecology, habitat selection, trees

The selection of habitat may have major consequences for the biology of an organism since it will influence the range of abiotic conditions and biotic interactions that the organism encounters (Sih et al. 1992). Individuals that select appropriate habitats may have access to shelters with appropriate thermal, hydric, and structural conditions, as well as sites in which they can maximize the chances of finding prey and sexual partners, and minimize the encounters with competitors and predators (Martin 2001). Several arachnids are known to exhibit precise habitat selection, and this behavior has been demonstrated to have a positive effect on the fitness of the individuals (e.g., Fritz & Morse 1985; Lubin et al. 1993; Morse & Stephens 1996; Goldsbrough et al. 2004).

The order Amblypygi comprises over 120 species, commonly known as whip spiders, which are widely distributed in the warmer tropical regions of the world (Weygoldt 2000). Representatives of the order have a dorso-ventrally flattened body, well-developed pedi-

palps bearing spines that are used for prey capture, and a long first pair of legs with sensory function. Most species are nocturnal and live in moist forests where they are found under rotting logs, between rock breaches, and inside caves (Weygoldt 2000). Recently, Heberts (2002) demonstrated that individuals of the whip spider *Phrynus parvulus* Pocock 1902 select microhabitats based on the tree surface, moss cover, and the presence of buttressing. In this study, we investigated if individuals of the Amazonian whip spider *Heterophrynus longicornis* (Butler 1973), which are commonly observed on the bark of large trees and inside natural cavities in fallen logs (Beck 1968; Weygoldt 1972a, 1977), also exhibit microhabitat selection.

The study was conducted during July 2004 in the Reserve 1501, also known as Km 41 (2°24'S, 59°44'W), a continuous "terra firme" (upland) forest that is one of the controls of the Biological Dynamics of Forest Fragments Project (BDFFP) in Central Amazon, nearly 80 km north of the city of Manaus, northern Brazil. The altitude in the reserve ranges from 50 to 150 m, and rainfall varies from 1900 to 2500 mm annually, with a dry season from June to October. For a detailed description of the area see Lovejoy & Bierregaard (1990).

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We used the 100 × 100 m network of trails in the reserve to establish five transects 4 m wide and ranging from 150 to 350 m in length. Along the transects we actively searched for the whip spiders on fallen logs and tree trunks up to 2 m of each side of the trails, so that the total sampled area was 6,628 m². Each transect was searched only once and the samples were conducted in five consecutive nights (between 20:00–01:00 h). We searched for whip spiders by scanning every tree with a diameter at breast height (DBH) ≥ 10 cm, from nearly 2 m down to the ground, which seems to be the foraging range of large whip spiders (Stewart & Woolbright 1996). All adult and subadult individuals were captured, sexed, and the cephalothorax width was measured with calipers. After manipulation, we returned the individuals to their original location and the trees where they were found were marked with a colored tag. The juveniles were not captured because they are very fragile and could be injured during the manipulation. For all individuals, we measured their height on the tree trunks using a tape measure and recorded their position on the bark surface according to three categories: facing downwards, facing upwards or parallel to the ground. Voucher specimens are deposited in the Museu de História Natural da Universidade Estadual de Campinas (ZUEC, Brazil) and Museu de Zoologia da Universidade de São Paulo (MZSP, Brazil).

In the morning after each sampling, we measured the DBH of all trees inside the transects, making a distinction between those on which *H. longicornis* were present versus those on which they were absent. We also scored the trees as positive or negative when buttressing was present or absent, respectively. Logistic regression was performed to determine whether the diameter of the trees could predict the absence (0) or presence (1) of *H. longicornis*. A Kolmogorov-Smirnov test was performed to compare the distribution of classes of DBH in trees with and without *H. longicornis*. The correlation between the size of the whip spiders (considering only subadults and adults) and the DBH of trees on which they were found was tested using a Spearman rank correlation. A chi-square goodness-of-fit was used to test the null hypothesis that the frequency of occurrence of individuals was independent of the presence

of buttresses. The expected values were generated based on the proportion of buttressing trees in our five transects.

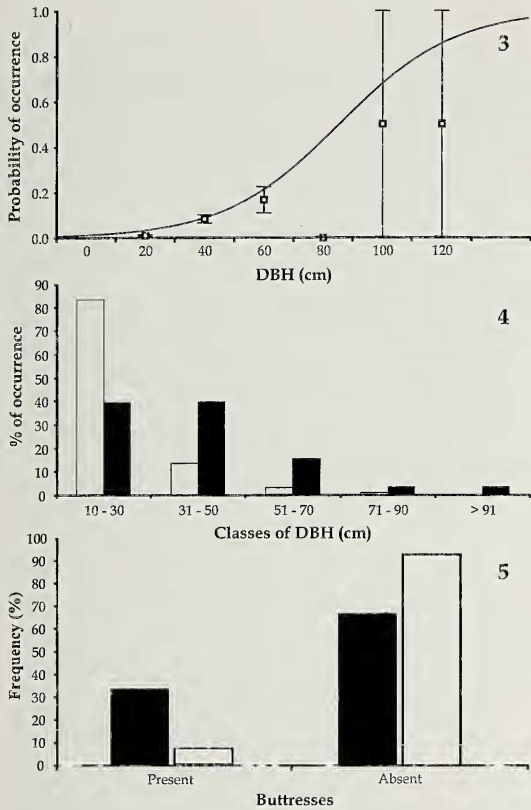
We sampled a total of 703 trees with DBH ≥ 10 cm, and on 31 we found individuals of *H. longicornis*. From the 46 individuals that were seen, 11 were juveniles in different stages of development, 10 were females (including three bearing egg sacs), and 25 were males. The size of the males ranged from 9.2 to 14.9 mm (mean ± SD = 12.4 ± 1.2 mm) and the size of the females ranged from 9.2 to 12.6 mm (10.7 ± 1.3 mm). Thirteen individuals (five females, six males, and two juveniles) were found on fallen logs and in all cases there were large cavities in these logs that were used as diurnal shelters. Thirty-three individuals (six females, 19 males, and eight juveniles) were found on the bark of living trees, 80.6% of which possessed burrows at their base that were also presumably used as diurnal shelters. Only two trees presented more than one individual: in one case they were a juvenile and a female, and in another case they were a male and a female. No intraspecific interaction was observed in the field.

The height of the individuals on the tree trunks ranged from 18 to 160 cm (77.2 ± 41.1 cm). The great majority of the individuals (78.3%) were facing downwards, and the remaining were facing upwards (8.7%) or parallel to the ground (13.0%). Amongst those facing downwards, it was common to observe individuals with the pedipalps raised and widely opened, in a typical hunting posture (Fig. 1). Two individuals were found consuming prey: a juvenile ate a cockroach and a female ate a ctenid spider (Fig. 2).

The probability of finding individuals of *H. longicornis* increased according to the DBH of the trees (Fig. 3). Nearly 80% of the trees in the transects had a DBH between 10 and 30 cm, but only 45% of the whip spiders were found in trees of this size category (Fig. 4). Thus, the distribution of classes of DBH in trees with and without *H. longicornis* was markedly different (Kolmogorov-Smirnov test, $\chi^2 = 27.07$; $d.f. = 2$; $P < 0.001$). There was a positive correlation between the size of the adult individuals and the DBH of the trees where they were found ($r_s = 0.523$; $n = 24$; $P = 0.008$). Finally, buttressing trees presented more individuals of *H. longicornis* than expected by chance (Fig. 5).



Figures 1–2.—1. Adult female of *Heterophrynus longicornis* in a typical hunting position facing downward on a tree trunk in Central Amazon; 2. Female of *H. longicornis* preying on a ctenid spider that climbed the tree trunk at night (photos by G. Machado).



Figures 3–5.—3. Logistic regression showing the increase in the probability of finding individuals of *Heterophrynus longicornis* according to the increase in the DBH of the trees in a continuous forest in Central Amazon ($\chi^2 = 28.79$; $d.f. = 1$; $P < 0.001$). In order to facilitate visualization, the DBH measurements were divided into classes and the data on presence (1) and absence (0) of whip spiders are presented as mean \pm SD for each class; 4. Distribution of classes of DBH of trees with (black bars) and without (white bars) individuals of *H. longicornis*; 5. Percentage of trees occupied (black bars) or not (white bars) by individuals of *H. longicornis* according to the presence of buttresses (Yates corrected, $\chi^2 = 44.00$; $d.f. = 1$; $P < 0.001$).

Our results provide quantitative support for the previous suggestion of Weygoldt (1972a) that *H. longicornis* prefers large trees bearing buttresses and presenting burrows at their base where the individuals hide during daytime. According to this author, this preference may be explained because buttresses provide shelters for the whip spiders. Working with *Phrynus parvulus* in a rain forest from Costa Rica, Hebets (2002) also showed that the individuals prefer large trees with buttresses, but no

explanation for such a pattern was provided. It is very common that buttressing trees accumulate a great amount of leaf litter at their base, and this microhabitat is used by many groups of invertebrates and vertebrates as shelter (e.g., Voris 1977; Cabanillas & Castellón 1999; Whitfield & Pierce 2005). It is possible that the whip spiders prey on individuals that leave the litter at night and climb on the trees. Indeed, the fact that most individuals of *H. longicornis* were found facing downward suggests that they were waiting for ascending prey. Additionally, the large flat area of buttressing could also provide an arena for courting, but Hebets (2002) showed that the choice of large buttressing trees by *P. parvulus* is not sex-specific.

Adult individuals of many species of whip spiders are territorial, and this is particularly pronounced in the males, which use formalized fights for defending their territories (Weygoldt 2000). In *H. longicornis*, a male and a female, and sometimes a whole family with small juveniles were found in the same tree hole (Weygoldt 1977). However, agonistic behavior between males of the same reproductive stage does exist in *H. longicornis*, although there is never any damage to the contenders (Weygoldt 1972b). The fact that most individuals found in this study were alone in a given tree or log suggests that, at least during part of their lives, adults of *H. longicornis* are territorial and/or intolerant to conspecifics of the same sex. Moreover, the positive correlation between the size of the whip spiders and the DBH of the trees on which they were found suggests that large individuals can hold the largest trees, which present a higher probability of presenting buttresses.

The results on habitat use by *H. longicornis* have some implications for the conservation of this large whip spider in the Central Amazon. Since individuals prefer large trees, the anthropogenic disturbance promoted by selective logging or the degeneration of the forest structure due to fragmentation and edge effect may have a negative effect on *H. longicornis*. Indeed, Bloch & Weiss (2002) showed that the density of *P. longipes* was greater in plots assigned to areas with a moderate history of anthropogenic disturbance (> 80% of tree cover) than plots assigned to coffee plantations (50–80% of tree cover) or intensive logging (< 50% of tree cover). In a similar way, if the

density of *H. longicornis* is negatively affected by the loss of tree cover, we predict that the small fragments, in which large trees are virtually absent (Laurance et al. 2000), may function as sink habitats for the whip spiders and in many of these Amazonian fragments the species may be locally extinct.

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